Consolidated Program for Research and Development for Welding of High Strength Steel Pipelines, #277 & 278

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13th QUARTERLY REPORT

Project WP#278: Development of Optimized Welding Solutions for X100 Line Pipe Steel

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Consolidated Program for Research and Development for Welding of High Strength Steel Pipelines #277 & 278

Project WP# 278: Development of Optimized Welding Solutions for X100 Line Pipe Steel

Background

To meet the increasing demand for energy in North America, oil and gas reserves in more remote and challenging regions are being developed where large volumes of natural gas will be transported by new long distance, high pressure transmission pipelines. Advanced pipeline designs utilizing high strength line pipe is a key element in meeting these increasing energy demands. A significant amount of laboratory research has been conducted on the development of X100 line pipe and associated welding technology; including, a few recent demonstration projects of limited size and scope. Accordingly, there are few welding process options proven for X100 and the knowledge resides within a small number of companies. The objectives of the proposed work are to establish the range of viable welding options for X100 line pipe, define essential variables to provide for welding process control that ensures reliable and consistent mechanical performance, validate the new essential variables methodology for relevant field welding conditions, and verify weld metal performance through a combination of small and large scale tests. Full implementation will be achieved through changes to applicable codes and standards.

Progress in the Quarter

Summaries of the technical status and results or conclusions to date are presented below for each of these tasks.

Task 1: State of the Art Review

The authors are working on Sections 10, 11 and 12. They have made final editorial changes have been made to Sections 1 through 9.

Task 2: Identification of Essential Variables

Subtask 2(c) – Fabrication, Testing, and Analysis of Baseline Welds

This task is essentially complete. The researchers have outlined sections of their respective task reports and are in the process of writing the drafts for inclusion in the final report.

Task 3(a): Physical simulation-Heat Affected Zone

CANMET researchers completed work on this task, including detailed analysis of experimental data, as well as, the background information necessary to prepare the final task report.

Task 3(b): Physical simulation-Weld Metal

CANMET and LECO researchers are continuing to collaborate on this task through detailed analysis of experimental data and have completed assembling the data. They have also prepared an initial draft of the final task report.

Task 3(c) Calibration of Thermal Models

CRES continued working on the weld metal microstructure modeling with new correlation between weld metal hardness, weld metal chemistry, and cooling times T_{85} or T_{84}. They applied the preliminary correlation based on several hardness data sets from real girth welds and Gleeble simulations to the thermal-microstructure model. CRES has completed the first round of simulations of the plate welding experiments. They are also making modifications to the correlation between hardness of weld metal and its chemistry and cooling times to improve the simulation results.

CRES, LECO, and CANMET have been in communication to assemble the modeling works throughout the project and their supporting experimental data in the preparation of the final project report.

Task 3(e) Testing and Analysis of Experimental Welds

This task is essentially complete. The team is working on the final report.

Task 4: Verification for Field Conditions and Extension to Other Processes

Mechanical testing of 5G welds on X100 pipe has been completed. Researchers from LECO, CANMET and CRES have held several technical exchanges to discuss the latest results from this work. They are using the results to provide feedback into other tasks within this project and related tasks in Project 277.
NIST has also begun the small scale fracture toughness tests.

Task 5: Large Scale Performance Validation

LECO has welded the grips on the pre-cracked curved wide plate specimens from the single torch welds and sent them to NIST for testing.

Task 7: Planning, Progress, and Review Meetings

Regular weekly teleconferences were held among team members of both Project 277 and 278 to coordinate work and the final report. The research teams have also conducted bi-weekly technical teleconference meetings that are intended to address specific topics that are being addressed in this research program.

Task 8: Reporting

The team completed the monthly and quarterly progress reports for the DOT.

Task 9: Peer Review

Project updates were presented at the PRCI Pipeline Program Research Exchange Meeting held February 1-3, 2011 in Atlanta, Georgia